Title: "But It Is a Dry Heat!"

Brief Overview:

During this learning unit students will be investigating the effects of climate conditions on the growth of an agricultural product in order to determine the ideal climate in which to grow this product. This investigation will accompany an identification, definition, and description of the major climate types using the Internet as the primary resource tool. The culminating activity will consist of an electronic media presentation created by the students.

Links to NCTM 2000 Standards:

- **Mathematics as Problem Solving**
  Students will demonstrate the ability to collect and analyze relevant data. They will then make conclusions and suggest a course of action based on the data.

- **Mathematics as Reasoning and Proof**
  Students will demonstrate the ability to form a hypothesis about the influence of climate factors on the growth of a plant, test it through an experiment, and make decisions based on the results.

- **Mathematics as Communication**
  Students will demonstrate the ability to use relevant data when communicating about the performance of the plants during the experiment.

- **Mathematics as Connections**
  Students will demonstrate their ability to make connections between the climate experiment models and real-world climate/agricultural situations.

- **Mathematics as Representation**
  Students will demonstrate their ability to use the climate experiment model situation to represent large-scale phenomena.

- **Number and Operation**
  Students will demonstrate the ability to convert daily and/or yearly average Celsius measurements into Fahrenheit and vice versa.

- **Measurement**
  Students will demonstrate the ability to collect measurable relevant data about the plants' performance. Students will demonstrate the ability to translate yearly rainfall measurements into daily rainfall measurements.

Links to National Science Education Standards:

- **Unifying Concepts and Processes**
  Students will demonstrate the ability to design, plan, conduct, and review an experiment in order to form a logical conclusion about the influence of climate conditions on plant growth.

- **Science as Inquiry**
  Students will be able to recognize the need for the use of a model in the climate experiment.

- **Physical Science**
  Students will demonstrate the ability to convert between Celsius and Fahrenheit temperature scales when working with daily and yearly temperature ranges.

- **Life Science**
  Students will demonstrate the ability to identify the adaptations and needs of various forms of life in different climate types using the Internet and an experimental model.

- **Science in Personal and Social Perspectives**
  Students will demonstrate the ability to recognize the influence of climate on the eating habits of resident populations through the examination of relevant examples.

Grade/Level:

Grades 6-7

Duration/Length:

Approximately 6 or 7 -- 50 minute -- sessions and 1 - 2 weeks for growth Activity #1
Approximately 6 or 7 -- 50 minute -- sessions for Activity #2
Approximately 5 or 6 -- 50 minute -- sessions for Activity #3
Activities 1 and 2 are designed to run concurrently.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Measuring and collecting relevant data and recording observations in an organized manner
- Power Point or other similar electronic media software
- Applying the Scientific Method in a lab exercise
- Identifying the major land masses
- Translating Fahrenheit to Celsius and vice versa.
  $?°C = (°F - 32°F) \bullet \frac{5°C}{9°F}$ [Converting Fahrenheit to Celsius]
  $?°F = \frac{9°F}{5°C} \bullet °C + 32°F$ [Converting Celsius to Fahrenheit]
- Calculating daily and yearly levels of rainfall using either given number
- Cooperative group work skills

Student Outcomes:

Students will be able to:

- plan, conduct, and reflect on a lab exercise.
- make a recommendation using information gathered from a lab exercise.
- effectively utilize the Internet as a primary resource for information.
- design, create, and present a presentation using electronic media.
- identify and describe the various climates on Earth .

Materials/Resources/Printed Materials:

- Plant seedlings (bean plants or any other locally-available, fast-growing plant)
- Terra cotta pots, one for each plant
- Aluminum foil to place inside the pots to seal the water in the dirt during experiment.
- Potting soil, without vermiculite
- Grow light or sunny window
- Heat Lamp and safety gloves for handling hot items
- Access to a large refrigerator
- Power Point or similar electronic media presentation program

- Timer
- Automatic on/off timer
- Past issues of National Geographic / travel magazines (if needed)
- A liquid measuring cup or beaker
- Calculators

Development/Procedures:

- **Activity #1 - Growth Rates vs. Climate Conditions**

  This activity involves the students observing seedlings placed in various climate conditions. Note to the teacher: Be sure to obtain all the plants from the same dealer and that the plants are free from any fungus, disease, or other conditions. This activity involves the use of a heat source, ensure that all students are aware of the safety precautions associated with this equipment.

  Session #1:
  1. Have the students create a list of the various fruits and vegetables that are available in their local supermarket or farmer's market. Emphasize the variety of the available produce.
  2. Discuss with the students where they think these items were grown.
  3. Discuss with the students why certain types of produce are not grown locally. Emphasize the climate of the local area versus the climate where the produce is cultivated.
  4. Make the available to the students examples/illustrations of agricultural crops from various global locations. Discuss with the students the difference and similarities between what they observe in these examples/illustrations and what is grown locally.

  Session #2:
  5. Show the seedlings to the students and explain to them that this type of plant can be grown easily locally, but not so in other parts of the world.
  6. Have the students, working in groups, brainstorm reasons why this plant can be grown locally. Acceptable answers include references to the favorable local climate conditions.
  7. Present to the students a scenario in which they are asked to determine -- through a lab investigation and Internet research -- some alternative global locations where they would recommend growing the seedlings.
  8. Discuss with the students the major climate possibilities around the world:
     a. high temperature and high moisture levels
     b. high temperature and moderate moisture levels
     c. high temperature and low moisture levels
     d. low temperature and low moisture levels
     e. low temperature and moderate moisture levels
     f. low temperature and high moisture levels
     g. moderate temperature and low moisture levels
     h. moderate temperature and moderate moisture levels
     i. moderate temperature and high moisture levels
  9. Explain to the students that since they are responsible for identifying in which of the climate types the seedlings would best survive, they will need to conduct an investigation. Focus on the need to use models for this investigation, and have the students supply reasons why using a model would be safer and more cost-effective.
  10. Ask the students to predict in which of the major climate types would they expect the seedlings to survive. The students must also be able to provide support for their prediction. Record these predictions on large sheets of paper and hang them about the room for the course of investigation to help focus the students.

Session #3

11. Students should then be assigned the task to design a simple experiment in which each of the climate conditions combinations can be tested and relevant data can be collected. It is strongly recommended that the teacher guide the students through the first few steps to model expectations. Display and review with the students the available materials to encourage creative thinking.

The use of a sequence chain organizer will greatly increase the students' understanding of this experiment as a process. It is recommended that these sequence chains be displayed throughout the experiment to aid in focusing the students. Although most students should be able to design a majority of the experiment independently, review the following suggested experimental conditions and controls:

- All plants will receive 6 - 8 hours of light under the grow light.
- All plants will receive some level of moisture appropriate to the species of plant.
- Colder conditions will be simulated using the refrigerator.
- Hotter conditions will be simulated using the heat lamp.
- Periodic measurement of data and recording of observations.

12. Each plant should experience a different set of conditions beyond the common conditions, suggested conditions are listed below:

Plant(s) "A" - 4 hours under the heat lamp and double the amount of water
Plant(s) "B" - 4 hours under the heat lamp and the normal amount of water
Plant(s) "C" - 4 hours under the heat lamp and half the amount of water
Plant(s) "D" - overnight storage in the refrigerator and half the amount of water
Plant(s) "E" - overnight storage in the refrigerator and the normal amount of water
Plant(s) "F" - overnight storage in the refrigerator and double the amount of water
Plant(s) "G" - no special storage and half the amount of water
Plant(s) "H" - no special storage and the normal amount of water
Plant(s) "I" - no special storage and double the amount of water

13. It is suggested that all plants be placed under the grow light for 6 to 8 hours and receive the specific amount of water at the beginning of that time span. After the grow light time has expired, plants A,B, and C should be moved to the heat lamps for 4 hours -- the heat lamp can be operated using a timer for convenience but should not be left unsupervised for safety reasons, while plants D, E, and F should be moved to the refrigerator for overnight storage. Plants G, H, and I should remain under the grow lights after they are turned off and remain there until the next day.

Session #4:

14. Students should create -- with teacher guidance -- a data chart on which to record their observations and collected data at regular set intervals. These observations may include plant height, leaf width/number, flower/seed appearance and production, and overall color and plant appearance. Have the students work together to summarize the results of the experiment into a coherent form. Students should make use of appropriate units or descriptive terms in their results statement.

Session #5:

15. After all the results have been determined, a discussion should be held to guide the students in forming their conclusions and supporting their conclusions using relevant data and observations gathered from the investigation.

Session #6:

16. A short writing task could be assigned at this point which focuses on the students' experience associated with this experiment.

- **Activity #2 - Climate Types around the Globe**

This activity involves the students using the Internet to identify the various climates around the world, as well as the flora and fauna native to those climates.

Sessions #1, 2 and 3:
1. Have the students - through the use of directed readings, video presentations, or illustrations - define the major climate types (i.e., desert, tundra, etc...) and where they can be located on the planet. The use of large scale world maps on which students can write the name of or color in the areas of each climate type is highly recommended. Allow students the opportunity to match the experimental condition models to the climates they think would most closely match them.

Sessions #4, 5, and 6:
2. Students should then be assigned one of the climates and directed to use the Internet to search for information about that specific climate. This Internet use should only follow instruction on the appropriate use of the Internet resources. Students should not be permitted to "surf" the Internet unsupervised or to visit sites not directly related to the topic. It is suggested that the teacher preview possible sites to compile a list of acceptable sites for students to visit and provide a guided note/worksheet for the students to follow.
3. During this Internet search students should focus on several questions; "Where can this climate be found?", "What types of plants and animals live in this climate?", "What adaptations do these animals and plants have that allows them to survive in this climate?", "What is the average yearly and/or daily rainfall?", "What is the average daily and/or yearly temperature range?", and "What agricultural products are produced in this climate?" If Internet access is not possible or reasonable, then students can utilize past issues of National Geographic in order to gather relevant information.

Session #7:
4. Students should be given the chance to convert the temperature information they have gathered from their Internet research from Fahrenheit into Celsius and vice versa. Furthermore, students should recalculate -- in both English and metric units -- the yearly amount of rainfall, if any, into a daily rate of rainfall and vice versa.

- **Activity #3 - Climate Presentations**

This activity involves the students using an electronic presentation software program -- such as Power Point -- to present the results of their experiment and Internet search.

1. Students, working in groups should plan, create, and present to their peers an electronic presentation about their assigned climate. The presentation should demonstrate an understanding of how to present data and information in a pleasing manner. The presentation should include:
    - The location of their assigned climate, including countries and continents.
    - The resident flora and fauna of their assigned climate.
    - The average daily and yearly rainfall -- in English and metric units -- of their assigned climate.
    - The average daily and yearly temperature ranges in both Fahrenheit and Celsius.
    - The agricultural products produced in this climate.
    - How this climate compares to their own local climate.
2. A final part of the students' presentations should be their recommendation of whether or not they would advise someone to grow the agricultural product tested in the lab in their assigned climate. An explanation of this recommendation must include data from the lab.

3. Student groups should also be expected to construct a "fact" sheet about their climate to distribute among the audience of their presentation. This is an opportunity to have the students make use of word processing programs.

Assessment:

- **Activity #1 Assessment Activities:**
  Student understanding of how to apply the Scientific Method can be assessed through a combination of both discussion and written products. It is recommended that the students produce -- and teacher review for accuracy, appropriateness, and logic -- the problem statement, hypothesis, sequence chain of the experimental procedure, summation of the data and observations, results statement, and conclusion statement. This assessment can be done using a rubric that reflects the specific standards established prior to this lab exercise. A suggested checklist rubric for this assessment:

  _____ Student states the problem accurately.
  _____ Student states a logical hypothesis that relates to the stated problem.
  _____ Student constructs a complete, step-by-step sequence chain of the experimental procedure including the necessary materials.
  _____ Student accurately records the relevant data.
  _____ Student summarizes the data and forms a statement based on the results.
  _____ Student forms logical conclusions that are based on the recorded data.
  _____ Student uses appropriate and respectful behavior during the activity.

  Five points for each checked item.

- **Activity #2 Assessment Activities:**
  Students should be evaluated on their ability to identify the specific climates from location and description. This can easily be done with a Jeopardy style game in which students need to supply questions to given answers. Students' Internet work should be assessed using a rubric that was created by the students and the teacher working in conjunction. This student-teacher interaction will establish a clear student understanding of what is acceptable and expected while working on the Internet. Spot checks and student self-evaluations of student work habits are also some effective methods to assess progress.

- **Activity #3 Assessment Activities:**
  Student groups should be assessed using another student-teacher made rubric to ensure understanding of the expectations. Periodic group meetings with the teacher also are advisable to assess the progress of the group's efforts. The final presentation should be assessed using a checklist of items. This checklist of items should include all the specific content information, as well as personal performance and overall presentation quality factors. A summative assessment could be a Jeopardy style game involving the data from the student groups' climate fact sheets and presentations.

Extension/Follow Up:

Some possible extensions and follow up activities include:

- Repeating the experiment using different types of plants or more than one plant at a time.
- Investigating the influence of water, air, and soil pollution on crop growth.
- Investigating the viability of hydroponic crop production.
- Creation and maintenance of student vegetable gardens and/or greenhouse.
- Investigating the expansion of the Sahara desert.

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